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Original Contribution

Bystander cardiopulmonary resuscitation for out-of-hospital cardiac arrest in the Hispanic vs the non-Hispanic populations☆

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Abstract

Study Objective: The aim of this study is to compare rates of bystander cardiopulmonary resuscitation (CPR) for Hispanic and non-Hispanic out-of-hospital cardiac arrest (OOHCA) victims in Arizona.

Methods: This is a secondary analysis of consecutive OOHCA victims prospectively enrolled into our statewide OOHCA quality improvement database between November 2004 and November 2006. Continuous data are presented as means ± SDs and analyzed using *t* tests; categorical data are presented as frequency of occurrence and analyzed using χ^2. The primary outcome was whether bystander CPR rates were different for Hispanic vs non-Hispanic OOHCA victims. Secondary comparisons were initial cardiac rhythms and survival to hospital discharge.

Results: There were 2411 OOHCA victims during the period of analysis. A total of 952 arrests were excluded because ethnicity was not documented; 80 arrests were excluded because they were traumatic. A total of 1379 arrests were included for analysis, of which 273 (19.8%) were Hispanic. Hispanics were less likely to receive bystander CPR than non-Hispanics (32.2% vs 41.5%; $P < .0001$). Hispanics and non-Hispanics were dissimilar with respect to age (53.2 ± 25 vs 64.5 ± 19.3 years; $P = .0001$), paramedic response time (5.1 vs 5.5 minutes; $P = .0006$), initial rhythm asystole (53.8% vs 44.5%; $P = .005$), and initial rhythm ventricular fibrillation (20.5% vs 26.7%; $P = .036$). Survival to hospital discharge (8.1% vs 7.1%) was not statistically different.

Conclusion: In the state of Arizona, significantly fewer Hispanic OOHCA victims receive bystander CPR than non-Hispanics.

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1. Introduction

Sudden cardiac arrest has been well established as a leading cause of death in the United States [1,2]. Estimates of the number of annual deaths from out-of-hospital cardiac arrest (OOHCA) are as high as 450 000 [1,3-5]. Despite the efforts of

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emergency medical service (EMS) systems with their use of defibrillators, advanced airway techniques, and advanced cardiac life support medications, in most of locations, survival rates from OOHCA remain less than 5% [6-10].

Studies have shown higher survival rates in victims of OOHCA who have an initial rhythm of ventricular fibrillation (VF) [9,11-14], and it has been shown that in the absence of the cardiopulmonary resuscitation (CPR), VF more rapidly degenerates to pulseless electrical activity and asystole [15]. Numerous investigators have shown that CPR significantly improves survival from OOHCA [6,16-20], and subsequently, bystander CPR has been established as a critical link in the American Heart Association (AHA) "Chain of Survival."

Prior studies that have examined ethnic and racial differences in the performance of bystander CPR and survival from OOHCA have generally focused on black populations. Black victims of OOHCA have consistently been shown to have lower rates of bystander CPR when compared with whites, and survival rate comparisons have shown conflicting results. In 1998, Chu et al [21] prospectively collected data on 1690 OOHCA victims, 13% black and 87% white. Black victims were less likely to receive bystander CPR (11% vs 20%). In 1993, Becker et al [22] published a review of 6451 nontraumatic OOHCA victims in the city of Chicago, of which approximately half were white and half were black. Blacks had a higher incidence of cardiac arrest and were less likely to receive bystander CPR (18% vs 25%). Finally, in 1994, Brookoff et al [23] specifically reviewed rates of bystander CPR in nontraumatic OOHCA victims. In over 1000 consecutive cases from Memphis, Tennessee black victims received bystander CPR significantly less frequently than whites (9.8% vs 21.4%).

Despite the fact that Hispanics represent a rapidly growing segment of the US population, there is a paucity of resuscitation literature focused on this group. The authors are aware of only one study presented in abstract form by Benson et al [24], which showed that Latino cardiac arrest victims were significantly less likely to receive bystander CPR than whites (12.8% vs 23.9%; $P < .0001$). We conducted a secondary analysis from our prospectively collected state of Arizona EMS OOHCA database to validate the findings of Benson et al in an independent setting and to evaluate those findings in the context of a broader statewide population. Specifically, the purpose of our analysis was to examine the null hypothesis that there would be no difference in the frequency of bystander CPR for Hispanic and non-Hispanic OOHCA victims in the state of Arizona.

2. Material and methods

Out-of-hospital cardiac arrest has been identified as a public health issue in Arizona. Subsequently, these incidents are exempt from the Health Insurance Portability and Accountability Act (HIPAA). Investigational review board approval was obtained from the University of Arizona to publish deidentified data as part of the Save Hearts in Arizona Registry and Education (SHARE) program.

2.1. Setting

The state of Arizona encompasses 113 635 square miles, with a resident population of 5 939 292, yielding 45.2 persons per square mile. An estimated 28.5% of the population is Hispanic [25]. Arizona has 167 fire departments, 84 municipal, and 83 rural, which are staffed by 10 063 emergency medical technician (EMT)-basics, 141 EMT-intermediates, and 3898 EMT-paramedics. Emergency medical service system response and dispatch vary significantly across the state depending on local protocols and resources. The state Bureau of EMS and Trauma Systems (BEMST) establishes the scope of practice, education, training, certification, and vehicle inspection guidelines, whereas 4 regional EMS organizations and individual EMS agencies set specific prehospital protocols.

2.2. Study design

The SHARE program was established in November 2004 as a state of Arizona public health program. Before implementation, a standard data collection tool and database were developed, and study variables were defined for use with each cardiac arrest. Entry criteria, time intervals, and nodal events conformed to Utstein recommendations, and additional variables were added. We conducted a secondary analysis of deidentified data from consecutive OOHCA, which had been prospectively enrolled into our statewide OOHCA quality improvement database from November 2004 through November 2006. Patients were excluded if their arrests were known to be traumatic in origin or if their ethnicity was unavailable. All other arrests were included in this analysis. The primary outcome measure was to determine if there was a significant difference in the rate of bystander CPR for Hispanic vs non-Hispanic OOHCA victims. Variables thought to potentially impact bystander CPR rates such as age of victim, sex of victim, location of arrest, and the witnessing of an arrest were also included in the analysis. Survival to hospital discharge was also reviewed as a secondary outcome measure, and, to that end, the known confounders EMS response time and initial cardiac rhythm were assessed.

2.3. Data collection and processing

Emergency medical service agencies and fire departments were asked to voluntarily submit all patient care reports for patients receiving CPR, defibrillation, or epinephrine who had no vital signs upon EMS arrival. Thirty participating

agencies representing approximately 70% of Arizona's population forwarded copies of their completed patient care forms to the full-time SHARE program Research and Quality Improvement Director. All data elements collected were manually extracted case by case by the same individual with 20 years experience collecting cardiac arrest data from EMS reports. Data were entered into a secure HIPAA compliant Microsoft Access (Microsoft Corp, Redmond, VA) database on a continuous basis. The database is coded with a data dictionary, is password protected, and resides on the secure server at the University of Arizona Sarver Heart Center. To assure accuracy, we cross-referenced data between first responding EMS agencies, private transporting agencies, and, when necessary, available hospital information.

Outcome data were obtained by the SHARE program Research and Quality Improvement Director and was entered into the aforementioned protected database. Death confirmation was obtained from the Arizona Department of Health Services Office of Vital Statistics. When no death confirmation was available after 3 months, survival was verified through the relevant base hospital manager.

Patient ethnicity was extracted from patient care reports and occasionally from hospital data. Locations were categorized into 3 groups as follows: public, extended care/medical facility, or private residence. Those performing bystander CPR were categorized as lay bystander or trained bystander. Employee of location unknown medical training, spouse, family other than spouse, friend/neighbor, and stranger were considered lay bystanders. Medically trained caretaker, law enforcement, medical personnel, and off-duty medical personnel were considered to have CPR as part of their job description and were classified as trained bystanders.

2.4. Statistical analysis

For the purposes of this report, data were abstracted from the database by the SHARE program Research and Quality Improvement Director who was not blinded to the study question. The data were then transported from Microsoft Access for Windows into SPSS 14.0 for Windows (SPSS, Inc, Chicago, IL) for statistical analysis by our statistician who was also unblinded to the primary outcome measure. Subjects with missing ethnicity data were excluded from the analysis. Continuous variables are presented as mean ± SD and are analyzed using the t test or the Mann-Whitney U test for nonnormal distribution. The proportion of patients who survived to hospital discharge in the Hispanic and non-Hispanic groups were compared using the χ^2 test or the Fisher exact test. A logistic regression analysis was used to determine the survival association of the Hispanic group compared with the non-Hispanic group while adjusting for potential confounders. A simple model was adjusted for age and sex, and a full model was adjusted for age, sex, location of arrest, witnessed arrest, bystander CPR, time to EMS arrival, and VF.

3. Results

There were a total of 2411 OOHCA victims during the surveyed period. A total of 952 (39%) arrest victims were excluded because ethnicity was not documented, and 80 were excluded because they were determined to be traumatic in nature. The remaining 1379 arrests were included for analysis. There were 273 (19.8%) Hispanic victims and 1106 (80.2%) non-Hispanic victims. With respect to the primary outcome measure, Hispanics were significantly less likely than non-Hispanics to receive bystander CPR (32.2% vs 41.5%; $P < .0001$). Hispanics were also less likely to receive lay bystander CPR (16.1% vs 25.8%; $P = .001$). The 2 groups were similar with respect to sex (female 34.4% vs 33.1%; $P = .674$) but were dissimilar with respect to age (mean age, 53.2 vs 64.5 years; $P = .0001$). Arrest locations and frequency of witnessed arrests were not statistically different in the 2 groups (Table 1).

Hispanics and non-Hispanics had similarities and differences with respect to factors known to affect survival. As previously mentioned, they were similar with respect to location of arrest and the witnessing of arrests and dissimilar with respect to age. In addition, they differed with respect to paramedic response time (5.1 vs 5.5 minutes; $P = .0006$), initial rhythm asystole (53.8% vs 44.5%; $P = .005$), and initial rhythm VF (20.5% vs 26.7%; $P = .036$).

The odds of survival to hospital discharge did not differ significantly between Hispanics and non-Hispanics in the overall analysis (8.1% vs 7.1%; odds ratio [OR] 1.2; 95% confidence interval [CI], 0.7-2.1) or the subgroup analysis

Table 1 Patient factors and CPR performance

Demographics	Hispanic (n = 273, 19.8%)	Non-Hispanic (n = 1106, 80.2%)	P
Age, mean ± SD (y)	53.2 ± 25.0	64.5 ± 19.3	.0001*
Sex, female (%)	34.4	33.1	.674
Witnessed arrest (%)	44.3	50.4	.074
Time to EMS arrival, mean (min)	5.1	5.5	.006*
Initial rhythm (%)			
VF	20.5	26.7	.036*
Pulseless electrical activity	20.9	22.5	.561
Asystole	53.8	44.5	.005*
Bystander CPR performed (%)	32.2	41.5	.005*
Lay-bystander CPR performed (%)	16.1	25.8	.001*
Location of arrest (%)			
Residential	65.9	68.2	.515
Extended Care or medical facility	15.8	16.4	
Public Area	18.3	15.5	

* $P < .05$.

Table 2 Outcome, OR, and 95% CI

Outcome	Hispanic (%)	Non-Hispanic (%)	OR (95% CI)
Survival to hospital discharge	8.1	7.1	1.2 (0.7-2.1)
Survival in VF	16.1	16.3	0.8 (0.4-1.9)
Survival in VF witnessed	17.9	21.6	0.7 (0.3-2.0)

The ORs were adjusted for age, sex, bystander CPR performed, witnessed arrest, VF, and EMS dispatch to arrival time interval.

witnessed VF arrest survival to hospital discharge (OR, 0.7; 95% CI, 0.3-2.0) (Table 2).

4. Discussion

Out-of-hospital cardiac arrest continues to represent a significant public health issue in need of improvement because published survival rates remain less than 5% in most locations [6-10]. Along with defibrillation, bystander CPR continues to be one of the few interventions that improve survival rates. A number of studies have shown that survival from OOHCA is highest in patients with an initial rhythm of VF [9,11-14]. Cummins et al [6] and Holmberg et al [18] have shown that CPR maintains VF in OOHCA victims, and in 1999, Steill et al [12] demonstrated an OR for survival of 2.98 in patients who received bystander CPR. In addition, in 1995, Swor et al [19] showed an improved rate of hospital discharge with bystander CPR [26-33].

In the 2005 US census, 14.4% of the US population is Hispanic, whereas 28.5% of Arizona's population is Hispanic [25]. Most of the prior studies analyzing disparities in OOHCA care have focused on comparisons between white and black populations, and only one prior abstract has compared Hispanic and non-Hispanic populations. In 2006, Benson et al compared treatment for Latino and white OOHCA victims in Los Angeles, CA, using the CARE-LA database. An analysis of 1239 consecutive patients included 573 whites and 211 Latinos. In arrests, which occurred in either a public place or a private residence, Latino cardiac arrest victims received bystander CPR in 12.8% of cases compared with 23.9% of cases for white victims. The difference persisted after controlling for disparities in education and socioeconomic status. Survival analysis was not published [24].

The primary objective of this analysis was to determine the incidence of bystander CPR in the Hispanic population and compare it with the non-Hispanic population. Benson et al is the only previous group to publish an evaluation of this question, and their study took place in the very distinct single city setting of Los Angeles, CA. We sought to validate Benson's findings in an independent setting and to expand upon them by evaluating rates of bystander CPR across the state of Arizona, which includes large cities and, additionally, numerous suburban and rural areas. As a secondary outcome measure, we reviewed survival to hospital discharge, which had never been published as a comparison between Hispanic and non-Hispanic OOHCA victims.

In our analysis of 1379 victims of OOHCA, lay bystander CPR was performed infrequently and was performed even less frequently for Hispanics than for non-Hispanics. The low rates of bystander CPR in the general population are consistent with those previously reported [9,10,13,19]. With the survival benefits of bystander-initiated CPR well established [6,9,11-14,18-20,26-33] and with bystander CPR's place as a critical link in the AHA Chain of Survival [34], educational efforts to increase knowledge and awareness of the techniques of CPR performance and its benefits are critical.

Because most of cardiac arrests occur in private residences [20], it can be assumed that many of the bystanders are of the same ethnicity. Subsequently, efforts to increase rates of bystander CPR must penetrate Hispanic and Spanish-speaking–only populations. Spanish language American Red Cross first aid classes and AHA CPR classes are available in Arizona, but it is unknown whether they reach the targeted populations. This must be reviewed. The Arizona BEMST has adopted continuous chest compression CPR (CCC-CPR) as the suggested measure for lay responders both with and without dispatch assistance in an attempt to increase rates of bystander CPR across the population. The BEMST experience is that CCC-CPR is easier and less costly to teach, and Hallstrom et al [35] have shown that it is less time-consuming for dispatchers attempting to prompt bystander providers. It is unknown whether dispatchers can effectively deliver CPR instructions in Spanish, but it might be hypothesized that the simplicity of CCC-CPR instructions would be easier to communicate than the more complex instructions associated with standard CPR. This possibility needs specific evaluation. Continuous chest compression CPR has the potential to obviate other suggested barriers to CPR performance. Its simplicity could diminish the effects of panic, whereas the lack of mouth-to-mouth ventilation avoids the fear of transmission of communicable diseases [36-40]. This education must reach Hispanic and particularly Spanish-speaking communities.

In our analysis, we evaluated survival hypothesizing that the expected relationship between bystander CPR and survival would be present. We theorized that this would lend a greater impact to our results, possibly allowing us to more aggressively spearhead public health initiatives and future research aimed at increasing rates of bystander CPR in Hispanics. Hispanics had lower rates of initial rhythm VF and higher rates of initial rhythm asystole as was to be expected with lower rates of bystander CPR. Interestingly, all rhythm survival and VF survival were the same between the 2 groups. This surprising result might be a consequence of the younger age and shorter EMS response times in

Hispanics, both factors which have been previously shown to increase chances of survival [41-48]. Further speculation is beyond the scope if this analysis and warrants future study.

The combination of lower bystander CPR rates in Hispanics than in non-Hispanics with similar survival rates should not be used to dilute the significance of bystander CPR. Bystander CPR has been shown time and again to improve survival from OOHCA, and subsequently, low rates of bystander CPR should be alarming. Educational efforts that seek to improve rates of bystander CPR in both the general population and particularly the Hispanic population are critical. The findings by Benson et al [24] suggest that the disparity in bystander CPR rates cannot be explained solely by education levels and socioeconomic status. Future research should survey Hispanic citizens to evaluate their perceptions of CPR. Further questions that should be examined include (1) Are Hispanics aware that CPR classes are available in Spanish? (2) What percent of Hispanics have previous training in CPR? (3) Were Hispanics trained in Spanish if it is their primary language? (4) Is there a cultural reason for not performing CPR? (5) Would the removal of mouth-to-mouth ventilation alleviate this obstacle? We must focus on decreasing the 91.9% mortality rate from OOHCA in Hispanics who average just 53 years of age.

4.1. Limitations

Our analysis has limitations that warrant discussion. This is not a prospective research study but rather an analysis of a quality improvement database. Ethnicity data were not available on 952 OOHCA victims, and subsequently, these subjects were excluded from the analysis. In the compilation of our database, most of ethnicity data are extracted from patient care reports that are completed at the time of the patient encounter. When ethnicity is not available from these reports, we are not able to easily obtain the information. We decided that retrospectively obtaining these data was not prudent especially considering the high mortality rate of the victims and the potential for involving already grieving families. It is possible that these missing data impacted our results; however, given our methods of determining ethnicity, there is no reason that a patient would be more or less likely to be excluded based on their ethnicity alone.

This analysis is also limited by its reliance on the voluntary participation of EMS systems, but because the participants are widely distributed and represent a majority of Arizona's population, we do not think that this represents a significant source of bias. In addition, as part of the maintenance of our database, we have secondary evidence that suggests that participating systems do so fully.

Given that this is a secondary analysis of our statewide OOHCA database, we were unable to question bystanders directly to determine why they performed or did not perform bystander CPR. We were also unable to specifically discern the ethnicity of the bystander.

Finally, it is possible that our results our not generalizable to communities or states with a smaller proportion of Hispanic residents because of a presumed higher percentage of crossover cases in which the victim and the bystander are of a different ethnicity. It should be noted, however, that given the high frequency of private residence arrests, the victim and the bystander will often be of the same ethnicity. In addition, the impact of low bystander CPR rates for Hispanic victims of OOHCA would seem to be largest in areas with high population densities of Hispanics.

4.2. Conclusions

In Arizona, bystander CPR is performed less frequently for Hispanic than non-Hispanic OOHCA victims. Focused research into the reasons for this disparity is needed. In view of the demographic evolution of the United States, public health measures that penetrate Hispanic communities and focus on increasing bystander CPR rates are of critical importance.

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